

**WHAT IS CLAIMED IS:**

1. A method of making a coated article comprising the steps of:

providing a glass substrate;

ion beam milling substantially an entire surface of the glass substrate so as to

5 reduce the thickness of the substrate by at least about  $2 \text{ \AA}$ ; and

depositing a coating system including at least one diamond-like carbon (DLC)

inclusive layer on at least a portion of the ion beam milled surface of the substrate

following said ion beam milling step so as to form the coated article.

2. The method of claim 1, wherein said ion beam milling step is performed in

a manner so as to increase scratch resistance (SR) of the coated article by at least a factor

of two.

3. The method of claim 2, wherein said ion beam milling step is performed in

a manner so as to increase the scratch resistance (SR) of the coated article by at least a

factor of three.

15 4. The method of claim 1, wherein said ion beam milling step is performed in

a manner so that an average surface roughness of the ion beam milled surface of the

substrate following said ion beam milling is no more than about 80% of what an average

surface roughness of the surface of the substrate was prior to said ion beam milling.

5. The method of claim 4, wherein said ion beam milling step is performed in a manner so that the average surface roughness of the ion beam milled surface of the substrate following said ion beam milling is no more than about 70% of what the average surface roughness of the surface of the substrate was prior to said ion beam milling.

5 6. The method of claim 5, wherein said ion beam milling step is performed in a manner so that the average surface roughness of the ion beam milled surface of the substrate following said ion beam milling is no more than about 60% of what the average surface roughness of the surface of the substrate was prior to said ion beam milling.

7. The method of claim 6, wherein said ion beam milling step is performed in a manner so that the average surface roughness of the ion beam milled surface of the substrate following said ion beam milling is no more than about 50% of what the average surface roughness of the surface of the substrate was prior to said ion beam milling.

8. The method of claim 1, wherein said ion beam milling step is performed so as to reduce the thickness of substantially the entire substrate by from about 2-100 Å.

15 9. The method of claim 8, wherein said ion beam milling step is performed so as to reduce the thickness of substantially the entire substrate by from about 2-50 Å.

10. The method of claim 9, wherein said ion beam milling step is performed so as to reduce the thickness of the entire substrate by from about 4-20 Å.

11. The method of claim 1, further comprising using an inert gas in an ion beam source when performing said ion beam milling step, so that ions resulting from an inert gas are directed toward the substrate in order to mill the surface thereof.

12. The method of claim 1, further comprising using at least argon (Ar) ions to  
5 mill the surface of the substrate.

13. The method of claim 1, wherein said ion beam milling step is performed in a manner so that an elongated linear focused ion beam is used to mill the surface of the substrate.

14. The method of claim 1, wherein said ion beam milling step is performed in a manner so that after said ion beam milling step the atomic percentage (%) of sodium (Na) present in the first 20 Å of the substrate adjacent the surface thereof is less than about 85% of what the atomic percentage (%) of sodium (Na) was in the first 20 Å of the substrate adjacent the surface thereof prior to said ion beam milling step.

15. The method of claim 14, wherein said ion beam milling step is performed in  
15 a manner so that after said ion beam milling step the atomic percentage (%) of sodium (Na) present in the first 20 Å of the substrate adjacent the surface thereof is less than about 75% of what the atomic percentage (%) of sodium (Na) was in the first 20 Å of the substrate adjacent the surface thereof prior to said ion beam milling step.

16. The method of claim 1, wherein said ion beam milling step is performed in a manner so that after said ion beam milling step the atomic percentage (%) of sodium (Na) present in the first 75 Å of the substrate adjacent the surface thereof is less than about 85% of what the atomic percentage (%) of sodium (Na) was in the first 75 Å of the substrate adjacent the surface thereof prior to said ion beam milling step.

17. The method of claim 16, wherein said ion beam milling step is performed in a manner so that after said ion beam milling step the atomic percentage (%) of sodium (Na) present in the first 75 Å of the substrate adjacent the surface thereof is less than about 75% of what the atomic percentage (%) of sodium (Na) was in the first 75 Å of the substrate adjacent the surface thereof prior to said ion beam milling step.

18. The method of claim 1, wherein said ion beam milling step is performed in a manner so that after said ion beam milling step the atomic percentage (%) of sulfur (S) present in the first 20 Å of the substrate adjacent the surface thereof is less than about 50% of what the atomic percentage (%) of sulfur (S) was in the first 20 Å of the substrate adjacent the surface thereof prior to said ion beam milling step.

19. The method of claim 1, wherein said depositing a coating system step comprises forming a hydrophobic coating system on the substrate, the hydrophobic coating system including the DLC inclusive layer and at least one fluoro-alkyl silane (FAS) compound inclusive layer provided over the DLC inclusive layer; and forming the hydrophobic coating system so that the resulting coated article has an

initial contact angle  $\theta$  of at least about 55 degrees, and an average hardness of at least about 10 GPa.

20. The method of claim 1, wherein the DLC inclusive layer includes  $sp^3$  carbon-carbon bonds.

5 21. The method of claim 1, wherein the coated article has an initial contact angle  $\theta$  of at least about 55 degrees.

22. The method of claim 21, wherein the coated article has an initial contact angle  $\theta$  of at least about 80 degrees.

23. The method of claim 19, wherein the FAS compound includes at least one  
10 of:  $CF_3(CH_2)_2Si(OCH_3)_3$ ;  $CF_3(CF_2)_5(CH_2)_2Si(OCH_2CH_3)_3$ ;  $CF_3(CH_2)_2SiCl_3$ ;  
 $CF_3(CF_2)_5(CH_2)_2SiCl_3$ ;  $CF_3(CF_2)_7(CH_2)_2Si(OCH_3)_3$ ;  $CF_3(CF_2)_5(CH_2)_2Si(OCH_3)_3$ ;  
 $CF_3(CF_2)_7(CH_2)_2SiCl_3$ ;  $CF_3(CF_2)_7(CH_2)_2SiCH_3Cl_2$ ; and  $CF_3(CF_2)_7(CH_2)_2SiCH_3(OCH_3)_2$ .

24. The method of claim 1, further comprising depositing at least one  
intermediate layer so as to be located between the substrate and the DLC inclusive layer  
15 following said ion beam milling step.

25. The method of claim 1, wherein said depositing step is performed in a manner such that the DLC inclusive layer has an average hardness of at least about 20 GPa.

26. The method of claim 1, wherein said depositing step comprises ion beam depositing the DLC inclusive layer using at least a first gas including silicon and carbon.

27. A method of making a coated article comprising the steps of:

providing a substrate;

5 ion beam milling substantially an entire surface of the substrate so as to thin the substrate and smoothen the surface of the substrate; and

depositing a coating system on at least a portion of the ion beam milled surface of the substrate following said ion beam milling step so as to form the coated article.

28. The method of claim 27, wherein said ion beam milling step is performed in a manner so as to increase scratch resistance (SR) of the coated article by at least a factor of two.

29. The method of claim 27, wherein said ion beam milling step is performed in a manner so that an average surface roughness of the ion beam milled surface of the substrate following said ion beam milling is no more than about 80% of what an average  
15 surface roughness of the surface of the substrate was prior to said ion beam milling.

30. The method of claim 27, wherein said ion beam milling step is performed so as to reduce the thickness of the entire substrate by from about 4-20 Å.

31. The method of claim 27, wherein said depositing step comprises ion beam depositing at least one DLC inclusive layer on the ion beam milled surface of the

substrate.

32. The method of claim 27, wherein the substrate comprises a soda-lime-silica glass substrate.

33. The method of claim 1, wherein the glass substrate comprises a soda-lime-silica glass substrate.

34. A coated article comprising:

an ion beam milled glass substrate; and

a coating system including at least one layer deposited on an ion beam milled surface of said glass substrate.

35. The coated article of claim 34, wherein said substrate is ion beam milled so as to increase the scratch resistance of the coated article.

36. The coated article of claim 35, wherein said coating system comprises at least one diamond-like carbon (DLC) inclusive layer.

37. The coated article of claim 36, wherein said substrate has less Na and S adjacent the ion beam milled surface thereof than it otherwise would have had if the substrate was not ion beam milled.

38. A method of making a coated article comprising the steps of:  
providing a glass substrate;

ion beam milling at least a portion of a surface of the glass substrate in order to make the surface more smooth; and

depositing a coating system including at least one diamond-like carbon (DLC) inclusive layer on at least a portion of the ion beam milled surface of the substrate

5 following said ion beam milling step so as to form the coated article.